

FORM PTO-1390  
(REV 10-2000)

U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

ATTORNEY'S DOCKET NUMBER

821-33

TRANSMITTAL LETTER TO THE UNITED STATES  
DESIGNATED/ELECTED OFFICE (DO/EO/US)  
CONCERNING A FILING UNDER 35 U.S.C. 371

U.S. APPLICATION NO. (If known, see 37 CFR 1.5)

09/831435

INTERNATIONAL APPLICATION NO.  
PCT/SE99/02029INTERNATIONAL FILING DATE  
November 9, 1999PRIORITY DATE CLAIMED  
November 9, 1998 and December 7, 1998TITLE OF INVENTION A METHOD AND DEVICE FOR AN EGR-SYSTEM AND A VALVE AS WELL AS A REGULATION  
METHOD AND DEVICE

APPLICANT(S) FOR DO/EO/US INGEMAR ERIKSSON AND MICAEL BLOMQUIST

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

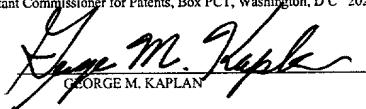
1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This is an express request to promptly begin national examination procedures (35 U.S.C. 371(f)).
4. ☒ The US has been elected by the expiration of 19 months from the priority date (PCT Article 31).
5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
  - a. ☒ is attached hereto (required only if not communicated by the International Bureau). WO 00/28203
  - b. ☒ has been communicated by the International Bureau.
  - c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☐ An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
  - a. ☐ are attached hereto (required only if not communicated by the International Bureau).
  - b. ☐ have been communicated by the International Bureau.
  - c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
  - d. ☒ have not been made and will not be made.
8. ☐ An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☐ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. ☒ An English language translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

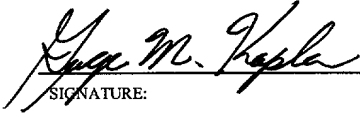
**Items 11 to 16 below concern document(s) or information included:**

11. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☒ A **FIRST** preliminary amendment.  
☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
14. ☐ A substitute specification.
15. ☐ A change of power of attorney and/or address letter.
16. ☒ Other items or information:

FORM PCT/IPEA/409, 2 SHEETS OF FORMAL DRAWINGS (FIGS. 1-4b), and FORM PCT/IB/306

## CERTIFICATION UNDER 37 C.F.R. § 1.10

I hereby certify that this correspondence and the documents referred to as enclosed are being deposited with the United States Postal Service on date below in an envelope as "Express Mail Post Office to Addressee" Mail Label Number EL820507487US addressed to: Assistant Commissioner for Patents, Box PCT, Washington, D.C. 20231.Dated:      MAY 9, 2001     
  
 GEORGE M. KAPLAN

|   |              |   |  |                                    |    |
|---|--------------|---|--|------------------------------------|----|
| U.S. APPLICATION NO. (if known, see 37 CFR 1.53)<br><b>09/831435</b>  |              | INTERNATIONAL APPLICATION NO.<br>PCT/SE99/02029 |  | ATTORNEY'S DOCKET NUMBER<br>821-33 |    |
| 17. <input checked="" type="checkbox"/> The following fees are submitted:<br><b>BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)) :</b><br>Neither international preliminary examination fee (37 CFR 1.482)<br>nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO<br>and International Search Report not prepared by the EPO or JPO ..... <b>\$1000.00</b><br>International preliminary examination fee (37 CFR 1.482) not paid to<br>USPTO but International Search Report prepared by the EPO or JPO. .... <b>\$860.00</b><br>International preliminary examination fee (37 CFR 1.482) not paid to USPTO but<br>international search fee (37 CFR 1.445(a)(2)) paid to USPTO ..... <b>\$710.00</b><br>International preliminary examination fee paid to USPTO (37 CFR 1.482)<br>but all claims did not satisfy provisions of PCT Article 33(1)-(4) ..... <b>\$690.00</b><br>International preliminary examination fee paid to USPTO (37 CFR 1.482)<br>and all claims satisfied provisions of PCT Article 33(1)-(4) ..... <b>\$100.00</b><br><br><b>ENTER APPROPRIATE BASIC FEE AMOUNT =</b> |              |   |  | <b>CALCULATIONS PTO USE ONLY</b>   |    |
|   |              |   |  |                                    |    |
| Surcharge of <b>\$130.00</b> for furnishing the oath or declaration later than <input type="checkbox"/> 20 <input type="checkbox"/> 30<br>months from the earliest claimed priority date (37 CFR 1.492(e)).   |              |   |  | \$                                 |    |
| CLAIMS  | NUMBER FILED | NUMBER EXTRA                                    | RATE   |                                    |    |
| Total claims  | 25 - 20 =    | 5   | X <b>\$18.00</b>   | \$ \$90.00                         |    |
| Independent claims  | 5 - 3 =      | 2   | X <b>\$80.00</b>   | \$ \$160.00                        |    |
| MULTIPLE DEPENDENT CLAIM(S) (if applicable)   |              |   | + <b>\$270.00</b>  | \$                                 |    |
| <b>TOTAL OF ABOVE CALCULATIONS =</b>  |              |   |  | \$ \$1,250.00                      |    |
| <input checked="" type="checkbox"/> Applicant claims small entity status. See 37 CFR 1.27. The fees indicated above<br>are reduced by 1/2.  |              |   |  | \$ -\$625.00                       |    |
| <b>SUBTOTAL =</b>   |              |   |  | \$ \$625.00                        |    |
| Processing fee of <b>\$130.00</b> for furnishing the English translation later than <input type="checkbox"/> 20 <input type="checkbox"/> 30<br>months from the earliest claimed priority date (37 CFR 1.492(f)).  |              |   |  | \$                                 |    |
| <b>TOTAL NATIONAL FEE =</b>   |              |   |  | \$ \$625.00                        |    |
| Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be<br>accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). <b>\$40.00</b> per property  |              |   |  | \$                                 |    |
| <b>TOTAL FEES ENCLOSED =</b>  |              |   |  | \$ \$625.00                        |    |
|   |              |   |  | Amount to be<br>refunded:          | \$ |
|   |              |   |  | charged:                           | \$ |
| a. <input checked="" type="checkbox"/> A check in the amount of \$ <u>\$625.00</u> to cover the above fees is enclosed.<br><br>b. <input type="checkbox"/> Please charge my Deposit Account No. <u>04-1121</u> in the amount of \$ _____ to cover the above fees.<br>A duplicate copy of this sheet is enclosed.<br><br>c. <input checked="" type="checkbox"/> The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any<br>overpayment to Deposit Account No. <u>04-1121</u> . A duplicate copy of this sheet is enclosed.  |              |   |  |                                    |    |
| <b>NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.</b>  |              |   |  |                                    |    |
| SEND ALL CORRESPONDENCE TO:<br>GEORGE M. KAPLAN, ESQ.<br><br>Dilworth & Barrese, LLP<br>333 Earle Ovington Blvd.<br>Uniondale, New York 11553<br><br>tel: (516) 228-8484<br>fax: (516) 228-8516   |              |   | <br>SIGNATURE:<br>GEORGE M. KAPLAN, ESQ.<br><br>NAME<br><u>28,375</u><br>REGISTRATION NUMBER |                                    |    |

09/831435

JC08 Rec'd PCT/PTO 09 MAY 2001

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

Applicant(s): Eriksson et al.

Examiner:

Serial No.: PCT/SE99/02029

Group Art Unit:

International

Filing Date: November 9, 1999

Dated: May 9, 2001

For: A METHOD AND DEVICE  
FOR AN EGR-SYSTEM AND... Docket : 821-32

Assistant Commissioner for Patents  
Washington, D.C. 20231

**PRELIMINARY AMENDMENT**

Sir:

Please enter the following Preliminary Amendment in the above-identified  
application:

IN THE CLAIMS:

Cancel Claims 1-19 without prejudice and substitute therefor Claims 20-  
44 found on the appended pages.

**REMARKS:**

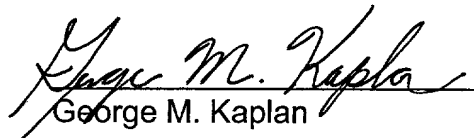
The claims in the application are now 20-44.

Favorable reconsideration of the application as amended is respectfully  
requested.

**CERTIFICATION UNDER 37 C.F.R. § 1.10**

I hereby certify that this New Application Transmittal and the documents referred to as  
enclosed therein are being deposited with the United States Postal Service on this date  
May 9, 2001 in an envelope as "Express Mail Post Office to Addressee" Mail Label Number  
EL820507487US addressed to: Commissioner of Patents and Trademarks, Washington,  
D.C. 20231.

Date: May 9, 2001

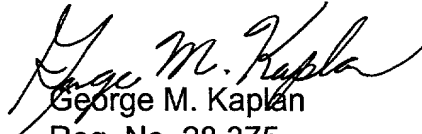
  
George M. Kaplan

09/831435

Claims 20-44 presented herein respectively correspond to Claims 1-25 appended to the International Preliminary Examination Report and amended to eliminate all multiple dependencies.

Early favorable action is earnestly solicited.

Respectfully submitted,  
DILWORTH & BARRESE LLP.

  
George M. Kaplan  
Reg. No. 28,375  
Attorney for Applicant(s)

DILWORTH & BARRESE LLP.  
333 Earle Ovington Blvd.  
Uniondale, NY 11553  
(516) 228-8484

20. A method for recirculating a part of exhaust gases from an exhaust pipe (6,9,) of a diesel engine (1) to an inlet of the engine, the exhaust gases being diverted from the exhaust pipe (6,9) and directed through a recirculation conduit (10) to a controllable valve device (12) arranged between the engine and an air intake (2) thereof to enable supply of air/recirculated exhaust gases in a desired relation to a combustion chamber of the engine, the valve device comprising dampers (20,21) arranged in inlet channels (17,18) for the recirculated exhaust gases and air respectively, characterized in that at least one of the dampers (20,21) always is maintained open and that the other damper (20,21) is closed by means of a drive motor (22) common to the dampers.
21. A method according to claim 20, characterized in that the exhaust gases from the exhaust pipe (6,9) are diverted after a catalyst (7) and a particle filter (8).
22. A method according to claim 20, characterized in that the relation air/recirculated exhaust gases is regulated by means of a control device (13) controlling the valve device (12) based on information (14, 15, 16) supplied as to the actual operational state of the engine (1).

23. A method according to claim 20, characterized in that the exhaust gases in the recirculation conduit (10) are cooled in a cooler (11) arranged in the recirculation conduit (10).
24. A method according to claim 20, characterized in that in a super charged diesel engine the recirculated exhaust gases are supplied between the air intake (2) and a super charger (4).
25. A device for recirculating a part of the exhaust gases from an exhaust pipe (6,9) of a diesel engine (1) to an inlet of the engine, a recirculation conduit (10) being provided for diverting the exhaust gases from the exhaust pipe (6,9) and directing them to a controllable valve device (12) arranged between the engine and an air intake (2) thereof for enabling supply of air/recirculated gases in a desired relation to a combustion chamber of the engine (1), the valve device comprising dampers (20,21) arranged in inlet channels (17,18) for the recirculated exhaust gases and air respectively, characterized in that the valve device is arranged to always maintain at least one of the dampers open and that a drive motor (22) common to the dampers is arranged to close the other of the dampers (20,21).



32. A device according to claim 25, characterized in that the valve device (12) comprises a first axle (23) on which a first one (20) of the dampers is arranged and a second axle (24) on which a second one (21) of the dampers is arranged, the first and second axles (23,24) being concentric, and that both axles (23,24) are arranged to be rotatable by the drive motor (22).
33. A device according to claim 32, characterized in that the first axle (23) is connected to a first actuation arm (26), that the second axle (24) is connected to a second actuation arm (27) and the valve device (12) comprises an actuation pin (25) which is movable by means of the drive motor (22) in order to rotate the first axle (23) and the second axle (24) by interaction with the first actuation arm (26) and the second actuation arm (27), respectively, so as to control the position of the dampers (20,21).
34. A device according to claim 33, characterized in that the valve device (12) comprises springs (28,29) acting on the actuation arms (26,27) so as to spring load each damper (20,21) towards an open position.
35. A valve for mixing two fluids flowing through two inlet channels (17, 18), characterized in that dampers (20,21) are arranged in both inlet channels (17,18), that at least one of the dampers always is open and that a common motor (22) is arranged to close the other of said dampers (20,21).



36. A valve according to claim 35, characterized in that the motor is a step-motor (22) arranged to operate one of the dampers (20,21) at a time and adjust the same into an arbitrary position.
37. A valve according to claim 36, characterized in that both dampers (20,21) in a normal position are spring loaded (28,29) to an open position.
38. A valve according to claim 36, characterized in that the valve (12) comprises a first axle (23) on which a first one (20) of the dampers is arranged and a second axle (24) on which a second one (21) of the dampers is arranged, the first and second axles (23,24) being concentric, and that both axles (23,24) are arranged to be rotatable by the motor (22).
39. A valve according to claim 38, characterized in that the first axle (23) is connected to a first actuation arm (26), that the second axle (24) is connected to a second actuation arm (27), and that the valve (12) comprises an actuation pin (25) which is moveable by means of the motor (22) in order to rotate the first axle (23) and the second axle (24) by interaction with the first actuation arm (26) and the second actuation arm (27), respectively, so as to control the position of the dampers (20,21).

40. A valve according to claim 39, characterized in that the valve (12) comprises springs (28,29) acting in the actuation arms (26,27) so as to spring load each damper (20,21) towards an open position.
41. A method for regulating a diesel engine, a part of the exhaust gases from the diesel engine being recirculated to the inlet thereof and a supply of fresh air and recirculated exhaust gases to the diesel engine being regulated by means of a valve device (12) controlled by a control device (13) to regulate the relation between the supplied fresh air and recirculated exhaust gases, characterized in that the control device (13) is supplied with information from a Lambda probe (14), an engine speed sensor (15) and an engine load sensor (16) so as to regulate the air/fuel relation of the diesel engine by means of said information and the valve device.
42. A regulating method according to claim 41, characterized in that a valve for mixing two fluids flowing through two inlet channels (17,18) and having dampers (20,21) arranged in both inlet channels (17,18), at least one of the dampers always being open with a common motor (22) being arranged to close the other of said dampers (20,21), is used as the valve device.

43. A regulating device for a diesel engine, comprising means (10) for recirculating a part of exhaust gases from the diesel engine to an inlet thereof and a valve device (12) controlled by a control device (13) for regulating supply of fresh air and recirculated exhaust gases to the diesel engine so as to regulate the relation between supplied fresh air and recirculated exhaust gases, characterized in that a Lamda probe (14) , an engine speed sensor (15) and an engine load sensor (16) are connected to the control device (13) to supply information thereto and that the control device (13) is arranged to regulate the air/fuel relation of the diesel engine by means of said information and the valve device (12).
44. A device according to claim 43, characterized in that the valve device is a valve for mixing two fluids flowing through two inlet channels (17,18) and having dampers (20,21) arranged in both inlet channels (17,18), at least one of the dampers always being open with a common motor (22) being arranged to close the other of said dampers (20,21).

2/PRTS

5

A method and device for an EGR-system and a valve as well as a regulation method and device

10 The present invention is related to a method and a device for an EGR-system (Exhaust Gas Recirculation), particularly for use in heavy-duty diesel engines. The invention also relates to a valve which is particularly suited for the method and device according to the invention but the valve may also find use within other  
15 fields. Finally, the invention is also related to a regulation method and device for a diesel engine.

In order to reduce the contents of hazardous exhaust gases, particularly nitrogen oxide (NOx), so called EGR-systems are  
20 used since many years in many types of combustion engines. Such systems admit a part of the exhaust gases to be recirculated to the intake system of the engine, where it is mixed with the intake air and is conveyed further to the combustion chamber of the engine. The recirculated exhaust gases replace  
25 a part of the intake air and have a reducing effect on the formation of NOx. A so called EGR-valve is then placed in connection with the exhaust system of the engine, the purpose of said valve being to regulate the amount of recirculated exhaust gases.

30 A method and a device according to the precharacterising parts of enclosed claims 1 and 6 are disclosed in DE A1 4 007 516. Although this prior art makes it possible to use an EGR-system in super charged diesel engines, where the pressure in the in-  
35 take system downstream of the super charger is higher than the pressure in a recirculation conduit from an EGR-valve some

09/831435, 09/22/01

important disadvantages are inherent in this prior art. Thus, the valve device comprises separate dampers arranged in the EGR-recirculation channel and an air intake channel. Separate drive motors are provided for these dampers, a fact which makes the valve device complicated and this also applies for a control device therefor.

### OBJECT OF THE INVENTION

A primary object of the present invention is to provide a method enabling a more reliable and simple regulation of the relation air/recirculated exhaust gases. As to the device according to the invention, the aim is to simplify the valve device and provide for a more reliable and simple control thereof.

A secondary object of the invention is to provide a valve suitable for mixing two fluids flowing through two inlet channels. Such a valve should be suitable for general purposes but is particularly useful in an EGR-system for diesel engines, including super charged diesel engines.

A tertiary object of the invention is to provide a regulation method and device providing for improved regulation possibilities with regard to a diesel engine provided with an EGR-system.

### SUMMARY OF THE INVENTION

The primary object of the invention is achieved by the features defined in the characterising parts of claims 1 and 6. The design of the valve device as comprising two dampers, where at least one of the dampers always is open and where the other of the dampers is closable by means of a drive motor common to the dampers provides for a simple design and a reliable operation.

The secondary object of the invention is achieved by means of the valve as defined in the characterising part of claim 13.

5 The tertiary object of the invention is achieved by means of the regulation method and device as defined in the characterising parts of claims 16 and 18. Thus, this aspect of the invention is based on use of probes and sensors connected to a control device for the valve device so as to enable regulation not only of the relation air/recirculated exhaust gases but also regulation of  
10 the air/fuel relation of the engine. This aspect of the invention provides for an improved overall regulation of the engine and a smaller amount of pollution.

15 Preferable developments of the basic aspects of the invention are defined in dependent claims.

20 The use of an EGR-system as contemplated by the invention on an engine provided with a catalyst and a particle filter according to the prior art results in a substantial reduction of the NOx contents. This reduction may be up to 50% and makes it possible to upgrade existing diesel engines to present emission requirements and to upgrade modern diesel engines to future emission requirements.

## 25 BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be described by means of non-limiting embodiments illustrated in the drawings, where

30 Fig 1 illustrates a diagrammatical view of an EGR-system according to the invention;

Fig 2a illustrates a sectioned valve according to the invention in one end position;

Fig 2b is a section view of the valve in Fig 2a as viewed in the direction of the arrow B-B;

Fig 3a illustrates a sectioned valve according to the invention in an intermediate position;

Fig 3b illustrates a section view of the valve in Fig 3a as viewed in the direction of the arrow B-B;

Fig 4a illustrates a cut valve according to the invention in a second end position; and

Fig 4b illustrates a section view of the valve in Fig 4a as viewed in the direction of the arrow B-B.

#### DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Fig 1 is a diagrammatical view showing the parts, which are essential to the invention, of a combustion engine indicated with the reference character 1. The engine is in the selected embodiment example a turbo charged diesel engine but as already mentioned the engine may be a diesel engine without super charging or a diesel engine with a different type of super charging than a turbo charger. Air is taken to the engine 1 through an air intake, an air filter 2, and is directed via an inlet air channel 3 to a turbo charger 4, where the air is super charged and then conveyed further through an intercooler 5, where the super charged air is cooled down before it is conveyed into the engine 1. The exhaust gases from the engine 1 are first directed through the second side of the turbo charger 4, namely that side which is the driving one, and then through an exhaust pipe 6, a catalyst 7 and a particle trap 8 to finally be emitted to the open air via an end pipe 9.

From the end pipe 9, i.e. an extension of the exhaust pipe after the catalyst and particle trap, there is a branch, a recirculation

conduit 10, to recirculate from the exhaust gases a part thereof to the engine. The recirculation conduit 10 passes suitably through a cooler 11 to cool down the recirculated exhaust gases and it connects to the inlet air channel 3 via a valve device 12 controllable by means of an EGR control device 13. The valve device 12 may, with the assistance of the EGR control device 13, regulate the relation between the supplied amount of fresh air from the inlet air channel 3 and the supplied amount of recirculated exhaust gases from the recirculation conduit 10.

The EGR control device 13 regulating the valve device 12 is supplied with information about the actual operational state of the engine from a.o. a Lambda probe 14, a sensor 15 for the number of revolutions of the engine and a sensor 16 for engine load and this control device is programmed to control the valve device 12 and, accordingly, the mixing relation fresh air/exhaust gases for the purpose of minimising the contents of hazardous substances leaving the end pipe 9 and being emitted into the open air. The programming of the EGR control device 13 occurs in a previously known manner with regard to the relations between the different factors given hereinabove. As is well known, a Lambda probe provides an output signal varying with the oxygen contents of the exhaust gases. The engine load sensor 16 may for instance be a throttle position sensor and/or a sensor sensing the amount of fuel injected to the engine. Also other sensors than those mentioned may be added to achieve a refined regulation.

The valve device 12 may comprise separate valves in the inlet air channel 3 and in the recirculation conduit 10, said valves then being separately controllable by the EGR control device 13. Alternatively the valve device 12 may also comprise a unit, in which flows from the inlet air channel 3 and the recirculation conduit 10 may be selectively brought together, by means of valves contained in the valve device, to a common output flow, which is conveyed further to the turbo charger for super charg-



ing and introduction into the engine via the intercooler 5. A particularly suitable valve device 12 in one unit is a particular part of the invention and will be described more closely hereunder.

- 5 The valve illustrated in Figs 2-4 is a type of mixing valve providing for mixing of two in-flowing fluids in such a manner that the in-flowing fluid in one of the two inlet channels may be regulated from 0 to maximum, and thereafter the in-flowing fluid in the second inlet channel from a maximum to 0.

10

In use of the valve according to the invention as illustrated in Figs 2-4 as a valve device 12 in the method or device according to the invention, the inlet air channel 3 is connected to the second inlet channel 18 of the valve, whereas the recirculation conduit 10 is connected to the first inlet channel 17 of the valve. Furthermore, there is in the valve an outlet channel 19, which in the present embodiment conveys the gases mixed in the valve to the turbo charger 4. In both inlet channels 17 and 18, there are dampers 20 and 21, which are pivotable between an open and a closed position by means of an adjustment motor 22, for instance a step motor, to open or close the inlet channels. The two dampers 20, 21 are placed on concentric axles 23, 24, which are rotatable by means of the adjustment motor 22 and an actuation pin 25 driven by the motor, said actuation pin being capable of pivoting actuation arms 26, 27 connected to the axles 23 and 24 respectively. The actuation arms 26, 27 are spring loaded by one or more springs 28, 29 to a normal position, illustrated in Fig 3, where both dampers 20, 21 are held in a position such that the inlet channels 17, 18 are open.

30

In the position illustrated in Fig 2a, b, which is a starting position, the adjustment motor 22 has, by means of its actuation pin 25 and by means of the actuation arm 26, rotated the damper 20 to a closed position, and thus, the first inlet channel 17 connected to the recirculation conduit 10 is closed and no exhaust gases may be recirculated to the turbo charger and the engine.

35

5 The second actuation arm 27 is maintained in its normal position by the spring 29, which means that the damper 21 in the second inlet channel 18 connected to the inlet air channel 3 is maintained in its normally opened position and allows free flow of inlet air through the valve via the outlet channel 19 to the turbo charger. The adjustment motor 22 is controlled by the EGR control device 13 to regulate the relation between fresh air via the inlet air channel 3 and recirculated exhaust gases via the recirculation conduit 10. In the position with the damper 21 open, the adjustment motor 22 may rotate, by means of its actuation pin 10 25 and by means of the actuation arm 26, the damper 20 from the entirely closed position shown in Fig 2a, b to the position which is shown in Fig 3a, b where also the damper 20 is in such a position that also the first inlet channel 17 is open. The adjustment motor may also adjust the damper 20 into any position between these two end positions.

15 The position illustrated in Fig 3a, b, which is the normal position for the adjustment motor 20, is such that the actuation pin 25 of the adjustment motor does not actuate any of the actuation arms 26, 27 but they are maintained by the springs 28, 29 in a normal position, where, accordingly, the dampers 20, 21 open both inlet channels 17, 18.

20 Fig 4a, b illustrates a position contrary to the one in Fig 2a, b. Thus, the adjustment motor 22 has by means of its actuation pin 25 and by means of the actuation arm 27 rotated the damper 21 to a closed position, which means that the connection of the inlet air channel 3 with the outlet channel 19 is entirely interrupted whereas on the contrary the first inlet channel 17 25 connected to the recirculation conduit 10 is entirely open and allows the recirculated exhaust gases to freely flow further through the outlet channel 19 and then to the turbo charger 4 and further on to the engine. However, by means of the adjustment motor 22, the damper 21 may be adjusted into any intermediate position between the end positions illustrated in 30 35

Figs 3 and 4 to allow a desired amount, controlled by the EGR control device 13, of fresh air to be mixed with the recirculated exhaust gases.

5 Thus, with the valve according to the invention it becomes possible to control, in a simple manner, a three-way valve having two inlets and having a normal position, where both inlets are open so that one or the other of the inlets may be controlled steplessly whereas the remaining inlet is maintained open. The  
10 valve may of course be controlled in other manners than by means of the EGR control device 13 described above and it may be used in quite different connections than the one now described and where corresponding control properties are desirable.

15 In a regulation method according to the invention, a control device is used which is supplied with information from a lambda probe 14, a motor speed sensor 15 and an engine load sensor 16. The control device is connected to a valve device,  
20 corresponding to the valve device 12 described here-inabove, for regulation of the in-flowing amounts of air and/or recirculated exhaust gases to the engine. This valve device is arranged between the air filter and the inlet channel of the engine and may, as also has been described for the valve device 12,  
25 comprise separate valves in the inlet air channel and recirculation conduit, or a three-way valve of the kind also described hereinabove. The valve device is controllable in a corresponding manner as also described hereinabove, and the control device may therefore control, based on the input signals received, the  
30 air/fuel relation of the engine by regulating the amount of in-flowing air and simultaneously regulating the relation between the supplied fresh air and recirculated exhaust gases. This aspect of the invention is applicable with or without supercharging.

With the regulation method and device according to the invention it is possible to further decrease the NOx-contents in the exhaust gases exiting from the end pipe of a diesel engine.

NOTES SEITE 9

## CLAIMS:

- 5 1. A method for recirculating a part of exhaust gases from an exhaust pipe (6, 9) of a diesel engine (1) to an inlet of the engine, the exhaust gases being diverted from the exhaust pipe (6, 9) and directed through a recirculation conduit (10) to a controllable valve device (12) arranged between the engine and an air intake (2) thereof to enable supply of air/recirculated exhaust gases in a desired relation to a combustion chamber of the engine, the valve device comprising dampers (20, 21) arranged in inlet channels (17, 18) for the recirculated exhaust gases and air respectively, characterized in that at least one of the dampers (20, 21) always is maintained open and that the other damper (20, 21) is closed by means of a drive motor (22) common to the dampers.
- 10 2. A method according to claim 1, characterized in that the exhaust gases from the exhaust pipe (6, 9) are diverted after a catalyst (7) and a particle filter (8).
- 15 3. A method according to claim 1 or 2, characterized in that the relation air/recirculated exhaust gases is regulated by means of a control device (13) controlling the valve device (12) based on information (14, 15, 16) supplied as to the actual operational state of the engine (1).
- 20 4. A method according to any preceding claim, characterized in that the exhaust gases in the recirculation conduit (10) are cooled in a cooler (11) arranged in the recirculation conduit (10).
- 25 5. A method according to any preceding claim, characterized in that in a super charged diesel engine the recirculated exhaust gases are supplied between the air intake (2) and a super charger (4).
- 30 35

ART 34 AMEND

0001435 002101  
TOTAL 230 SET 230

6. A device for recirculating a part of the exhaust gases from an exhaust pipe (6, 9) of a diesel engine (1) to an inlet of the engine, a recirculation conduit (10) being provided for diverting the exhaust gases from the exhaust pipe (6, 9) and directing them to a controllable valve device (12) arranged between the engine and an air intake (2) thereof for enabling supply of air/recirculated exhaust gases in a desired relation to a combustion chamber of the engine (1), the valve device comprising dampers (20, 21) arranged in inlet channels (17, 18) for the recirculated exhaust gases and air respectively, characterized in that the valve device is arranged to always maintain at least one of the dampers open and that a drive motor (22) common to the dampers is arranged to close the other of the dampers (20, 21).
7. A device according to claim 6, characterized in that the drive motor (22) of the valve device (12) is controlled by a control device (13) regulating, by means of the positions of the dampers (20, 21), the relation air/recirculated exhaust gases in the valve device (12) based on information (14, 15, 16) supplied as to the actual operational state of the engine.
8. A device according to any of claims 6-7, characterized in that the recirculation conduit (10) is connected to the exhaust pipe (6, 9) of the engine after the catalyst (7) and a particle filter (8).
9. A device according to any of claims 6-8, characterized by a cooler (11) arranged in the recirculation conduit (10) to cool the recirculated exhaust gases.
10. A device according to any of claims 6-9, characterized in that in a diesel engine having a super charger, the valve (12) is arranged between the air intake (2) and the super charger.

11.A device according to any of claims 6-10, characterized in that the drive motor is a step-motor (22) arranged to operate one of the dampers (20, 21) at a time and adjust the same into an arbitrary position.

5

12.A device according to any of claims 6-11, characterized in that both dampers (20, 21) in a normal position are spring loaded (28, 29) to an open position.

10

13.A device according to any of claims 6-12, characterized in that the valve device (12) comprises a first axle (23) on which a first one (20) of the dampers is arranged and a second axle (24) on which a second one (21) of the dampers is arranged, the first and second axles (23, 24) being concentric, and that both axles (23, 24) are arranged to be rotatable by the drive motor (22).

15

14.A device according to claim 13, characterized in that the first axle (23) is connected to a first actuation arm (26), that the second axle (24) is connected to a second actuation arm (27), and that the valve device (12) comprises an actuation pin (25) which is moveable by means of the drive motor (22) in order to rotate the first axle (23) and the second axle (24) by interaction with the first actuation arm (26) and the second actuation arm (27), respectively, so as to control the position of the dampers (20, 21).

25

15.A device according to claim 14, characterized in that the valve device (12) comprises springs (28, 29) acting on the actuation arms (26, 27) so as to spring load each damper (20, 21) towards an open position.

30

16.A valve for mixing two fluids flowing through two inlet channels (17, 18), characterized in that dampers (20, 21) are arranged in both inlet channels (17, 18), that at least one of

35

the dampers always is open and that a common motor (22) is arranged to close the other of said dampers (20, 21).

5 17. A valve according to claim 16, characterized in that the motor is a step-motor (22) arranged to operate one of the dampers (20, 21) at a time and adjust the same into an arbitrary position.

10 18. A valve according to claim 16 or 17, characterized in that both dampers (20, 21) in a normal position are spring-loaded (28, 29) to an open position.

15 19. A valve according to any of claims 16-18, characterized in that the valve (12) comprises a first axle (23) on which a first one (20) of the dampers is arranged and a second axle (24) on which a second one (21) of the dampers is arranged, the first and second axles (23, 24) being concentric, and that both axles (23, 24) are arranged to be rotatable by the motor (22).

20 20. A valve according to claim 19, characterized in that the first axle (23) is connected to a first actuation arm (26), that the second axle (24) is connected to a second actuation arm (27), and that the valve (12) comprises an actuation pin (25) which is moveable by means of the motor (22) in order to rotate the first axle (23) and the second axle (24) by interaction with the first actuation arm (26) and the second actuation arm (27), respectively, so as to control the position of the dampers (20, 21).

25 30 21. A valve according to claim 20, characterized in that the valve (12) comprises springs (28, 29) acting on the actuation arms (26, 27) so as to spring load each damper (20, 21) towards an open position.

35



ART 34 AMDT

5 22. A method for regulating a diesel engine, a part of the exhaust gases from the diesel engine being recirculated to the inlet thereof and a supply of fresh air and recirculated exhaust gases to the diesel engine being regulated by means of a valve device (12) controlled by a control device (13) to regulate the relation between the supplied fresh air and recirculated exhaust gases, characterized in that the control device (13) is supplied with information from a Lambda probe (14), an engine speed sensor (15) and an engine load sensor (16) so as to regulate the air/fuel relation of the diesel engine by means of said information and the valve device.

10

15 23. A regulating method according to claim 22, characterized in that a valve according to any of claims 16-21 is used as the valve device.

20 24. A regulating device for a diesel engine, comprising means (10) for recirculating a part of exhaust gases from the diesel engine to an inlet thereof and a valve device (12) controlled by a control device (13) for regulating supply of fresh air and recirculated exhaust gases to the diesel engine so as to regulate the relation between supplied fresh air and recirculated exhaust gases, characterized in that a Lambda probe (14), an engine speed sensor (15) and an engine load sensor (16) are connected to the control device (13) to supply information thereto and that the control device (13) is arranged to regulate the air/fuel relation of the diesel engine by means of said information and the valve device (12).

25

30 25. A device according to claim 24, characterized in that the valve device is a valve according to any of claims 16-21.

1 / 2

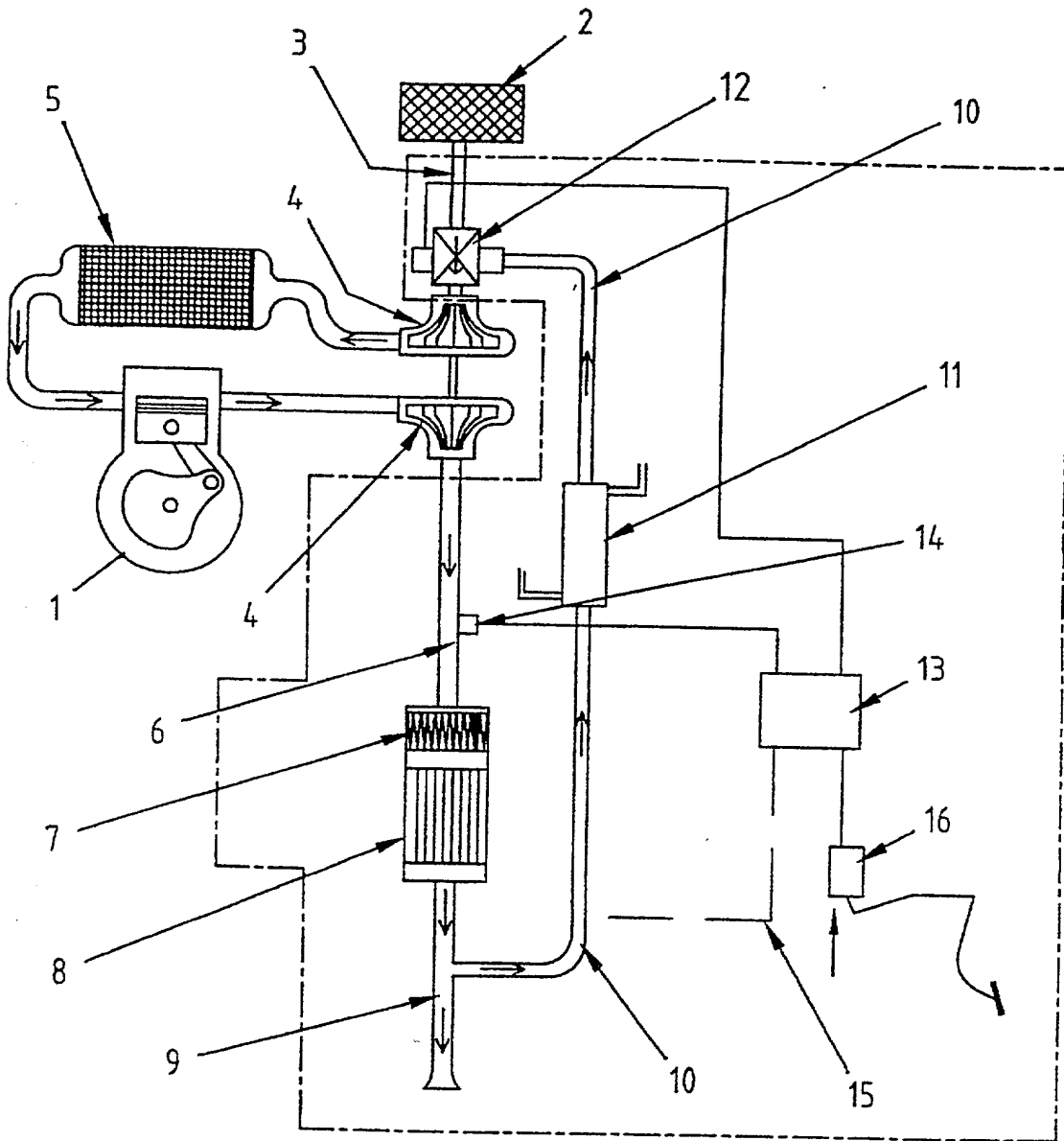


Fig. 1

2 / 2

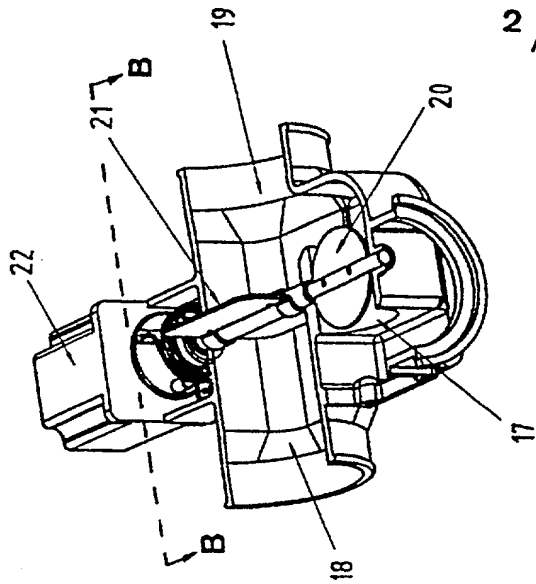


Fig. 4a

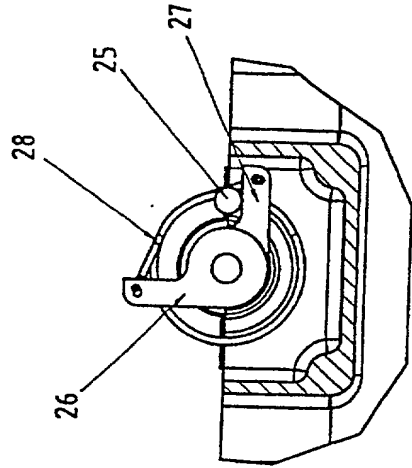


Fig. 4b

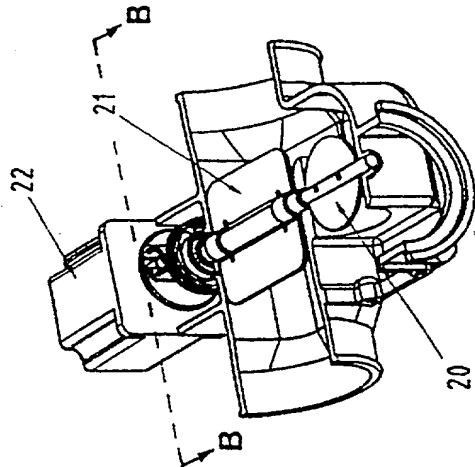


Fig. 3a

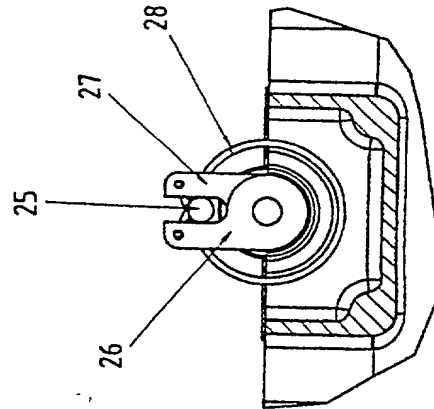


Fig. 3b

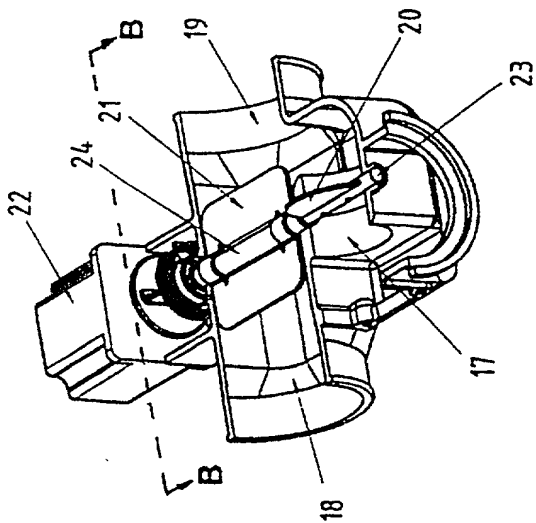


Fig. 2a

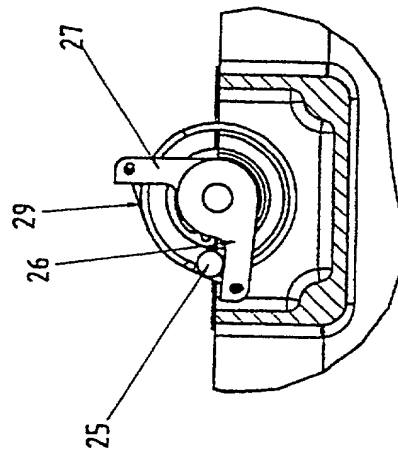


Fig. 2b

**Combined declaration for patent application and power of attorney (continued)**  
(includes Reference to PCT International Applications)

Attorney's docket No.

**PRIOR U.S. APPLICATIONS OR PCT INTERNATIONAL APPLICATIONS DESIGNATING THE U.S. FOR BENEFIT UNDER 35 U.S.C. 120:**

| U.S. APPLICATIONS |                  | STATUS (Check one) |         |           |
|-------------------|------------------|--------------------|---------|-----------|
| APPLICATION NO.   | U.S. FILING DATE | PATENTED           | PENDING | ABANDONED |
|                   |                  |                    |         |           |
|                   |                  |                    |         |           |

| PCT APPLICATIONS DESIGNATING THE U.S. |             |                                 |  |  |  |
|---------------------------------------|-------------|---------------------------------|--|--|--|
| APPLICATION NO.                       | FILING DATE | US SERIAL NO. ASSIGNED (if any) |  |  |  |
|                                       |             |                                 |  |  |  |
|                                       |             |                                 |  |  |  |

**POWER OF ATTORNEY:** As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. (List name and registration number):  
**DILWORTH, Peter G., Reg.No. 26,450; BARRESE, Rocco S., Reg.No. 25,253; CARTER, David M., Reg.No. 30,949; FARRELL, Paul J., Reg.No. 33,494; DELUCA, Peter, Reg.No. 32,978; CHAU, Frank, Reg.No. 34,136; CALDERONE, Adrian T., Reg.No. 31,746; KAPLAN, George M., Reg.No. 28,375; STEEN, Jeffrey S., Reg.No. 32,063; SCHMIDT, Joseph W., Reg.No. 36,920; FARRELL, Raymond E., Reg.No. 34,816; KASSNER, Russell R., Reg.No. 36,183; TRAINOR, Christopher G., Reg.No. 39,517; SAVIT, Glenn F., Reg.No. 37,437; LIKOUREZOS, George, Reg.No. 40,067; LOEFFLER, James M., Reg.No. 37,873; LEWIS, William E., Reg.No. 39,274; BITETTO, James J., Reg.No. 40,513; TUTUNJIAN, John G., Reg.No. 39,405; LEONARDO, Mark S., Reg.No. 41,433.**

Send correspondence to:

**DILWORTH & BARRESE**

**333 Earle Ovington Boulevard  
UNIONDALE, New York 11553**

Direct telephone calls to:

(name and telephone number)

**(516) 228-8484**

|                             |                         |                          |                             |
|-----------------------------|-------------------------|--------------------------|-----------------------------|
| FULL NAME OF INVENTOR (201) | FAMILY NAME             | FIRST GIVEN NAME         | SECOND GIVEN NAME           |
| <b>ERIKSSON</b>             | <b>ERIKSSON</b>         | <b>INGEMAR</b>           |                             |
| RESIDENCE & CITIZENSHIP     | CITY                    | STATE OR FOREIGN COUNTRY | COUNTRY OF CITIZENSHIP      |
| <b>KVISSLEBY</b>            | <b>KVISSLEBY</b>        | <b>SWEDEN</b>            | <b>SWEDEN</b>               |
| POST OFFICE ADDRESS         | POST OFFICE ADDRESS     | CITY                     | STATE & ZIP CODE/COUNTRY    |
| <b>GARNVÄGEN 15</b>         | <b>GARNVÄGEN 15</b>     | <b>KVISSLEBY</b>         | <b>SE- 862 91 KVISSLEBY</b> |
| FULL NAME OF INVENTOR (202) | FAMILY NAME             | FIRST GIVEN NAME         | SECOND GIVEN NAME           |
| <b>BLOMQUIST</b>            | <b>BLOMQUIST</b>        | <b>MICAEL</b>            |                             |
| RESIDENCE & CITIZENSHIP     | CITY                    | STATE OR FOREIGN COUNTRY | COUNTRY OF CITIZENSHIP      |
| <b>KVISSLEBY</b>            | <b>KVISSLEBY</b>        | <b>SWEDEN</b>            | <b>SWEDEN</b>               |
| POST OFFICE ADDRESS         | POST OFFICE ADDRESS     | CITY                     | STATE & ZIP CODE/COUNTRY    |
| <b>BLÅKLINTSVÄGEN 3</b>     | <b>BLÅKLINTSVÄGEN 3</b> | <b>KVISSLEBY</b>         | <b>SE- 862 34 KVISSLEBY</b> |
| FULL NAME OF INVENTOR (203) | FAMILY NAME             | FIRST GIVEN NAME         | SECOND GIVEN NAME           |
|                             |                         |                          |                             |
| RESIDENCE & CITIZENSHIP     | CITY                    | STATE OR FOREIGN COUNTRY | COUNTRY OF CITIZENSHIP      |
|                             |                         |                          |                             |
| POST OFFICE ADDRESS         | POST OFFICE ADDRESS     | CITY                     | STATE & ZIP CODE/COUNTRY    |
|                             |                         |                          |                             |

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

|                           |                           |                           |
|---------------------------|---------------------------|---------------------------|
| SIGNATURE OF INVENTOR 201 | SIGNATURE OF INVENTOR 202 | SIGNATURE OF INVENTOR 203 |
| <b>2001-05-09</b>         | <b>2001-05-09</b>         |                           |

**COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY**  
(includes Reference to PCT International Applications)

Attorney's docket No.

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

**"A method and device for an EGR-system and a valve as well as a regulation method and device"**

the specification of which (check only one item below):

☐ is attached hereto.

☐ was filed as United States application.

Serial No. \_\_\_\_\_

on \_\_\_\_\_

and was amended

on \_\_\_\_\_

(if applicable).

☒ was filed as PCT international application

Number PCT/SE99/02029

on November 9, 1999

and was amended under PCT Article 19

on \_\_\_\_\_

(if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the patentability of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed.

**PRIOR FOREIGN/PCT APPLICATION(S) AND ANY PRIORITY CLAIMS UNDER 35 U.S.C. 119:**

| COUNTRY<br>(if PCT indicate PCT) | APPLICATION NO. | DATE OF FILING<br>(day, month, year) | PRIORITY CLAIMED UNDER 35 U.S.C.<br>119                             |
|----------------------------------|-----------------|--------------------------------------|---|
| Sweden                           | 9803827-6       | November 9, 1998                     | <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO |
| Sweden                           | 9804240-1       | December 7, 1998                     | <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO |
|                                  |                 |                                      | <input type="checkbox"/> YES <input type="checkbox"/> NO            |

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) or PCT international application(s) designating the United States of America that is/are listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in that/those prior application(s) in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application(s) and the national or PCT international filing date of this application:

→